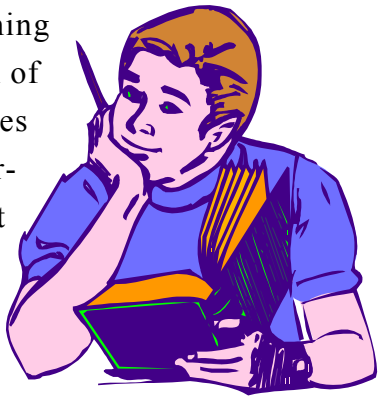
How We Learn–Our Brain's Information Processing System

Input comes into the perceptual register (brain stem) through any of the five senses. Forty-six percent of people have visual learning preferences, 35 percent have kinesthetic (touch) learning preferences, and 19 percent have auditory (sound) learning preferences. The bulk of instruction in school comes in the form of auditory information (lecturing), ignoring the learning preferences of over 80 percent of all students. This may well account for certain students who appear to "do well" in school with little effort compared to others. The brain is capable of processing 40 Kbps (kilobytes/second) of information. The majority of this information processing is subconscious, and enormous amounts of data about the environment are simply dumped as they are perceived (e.g., ongoing perceptual input regarding body skin temperature, how well our shoes fit our feet, the feeling of fabric against our skin, etc.). This processing happens in milliseconds.



The perceptual register can be thought of as "blinds" (Sousa) that can be open or closed to allow information to enter. No data go anywhere unless they first pass the brain stem requirements. Within the brain stem is the RAS (reticular system) that filters out and dumps extraneous input about our environment at the subconscious level. If the brain stem detects input it considers important (a siren), it queries the hippocampus, which in turn queries past experience, then past experience passes a message back to the brain stem through the hippocampus to pass the input through to short-term memory until a determination can be made whether the siren is a threat or not. This can still be happening at the subconscious level. If the siren is loud enough or close enough to be considered potentially important, the input may perhaps be passed through to the working memory, which is finally at the conscious level. It is at this working-memory level that learning occurs. If information is validated by the hippocampus and past experience, the information is tagged by the amygdala (emotions) or hippocampus (cognitive or psychomotor) for storage in REM sleep. If there is cognitive dissonance between incoming input and past experience, the information will likely be dumped. If there is fear or threat associated with the incoming input or the learning environment, it will likely be dumped. Only if the incoming input is found to make sense and/or be meaningful based on past experience, and consistent with the previously existing cognitive belief system and self-concept, will the material be tagged for storage.

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How we learn then becomes critical to our understanding of integration of technologies into the distance learning classroom. Consider then....

1. Use of multimodality instructional strategies is desirable for students with varying learning styles or "learning preferences."

2. Once information is stored in the brain, it is permanent, but we may lose the neural pathways to access the information. Use of multimodality strategies provides the brain with multiple pathways to the same information effectively increasing retention over time.

3. Almost 50 percent of us are visual learners and approximately 20 percent are auditory learners. Traditional lectures tend towards auditory learning. EDNET offers powerful multimodality technology teaching tools.

4. Use of humor (except sarcasm) can increase retention by as much as 15 percent. Laughter also increases oxygen uptake to the brain.

5. Use of color in visuals can increase retention by as much as 25 percent for visual learners. Color should not be random (the brain looks for patterns) but sequenced for sequential learning styles. This lends credibility to the use of computer presentation programs such as *PowerPoint* and *Persuasion* as well as use of the ELMO.

6. Priorities for the brain in descending order are (1) physical safety, (2) emotional security, and (3) higher-order thinking. Higher-order activities cannot function well unless numbers 1 and 2 are satisfied. Students cannot learn well if there is fear in the learning environment, including teacher sarcasm.

7. Associative use of metaphors increases retention by 40 percent or better.

8. Old Chinese proverb: "Whoever explains, learns." The brain will retain more when students can verbalize while learning. Synergy learning strategies suggest students should mix with a variety of learning partners for diverse viewpoints; multimodality learning strategies can address various learning styles.

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9. Students should stand and move about periodically to increase the blood flow to the brain which will stimulate learning. Following curriculum activities, the teacher should allow time for clarification and build in a reporting structure so students get a chance to vocalize and process what they have learned.

10. The brain must be able to attach (1) sense (Does it make sense? Is it consistent with what is already stored?) or (2) meaning (Is it relevant?), or both, in order to store the data. When the brain dumps incoming data, it's gone. When the brain stores data, it's permanent, although neutral pathways to access the data may be lost. Establishing multiple pathways to the data (multimodality teaching strategies) ensures longer access to the data. Making instructional "sense" to the learner, but there is typically little "meaning" associated with traditional instruction. Hence, "I'll never need to know that!" The brain must see a future use of the data or it will dump it.

11. When developing instruction, be aware of the brain's limitations. (Capacity and attention span are based on age.)

12. New learning always depends on references to past experiences.

13. It is accepted that students learn in different ways and teachers must provide instructional methods reaching the learning styles of all students. Students should be taught about their
learning style preferences and the teacher should guide them in selecting materials and techniques to help them learn. Student should also be encouraged to develop methods helping them to learn in their non-preferred learning style. Teachers should know what their (teacher)learning and teaching style is so they can avoid a mismatch in working with students. Educational technology is an excellent way to support and enhance students' learning styles.

The above information was taken from lecture notes by Dr. David Sousa. Workshop at Davis School District, *"How the Brain Learns: New Insights for Educators,"* August 20, 1997.